EPA/600/R-07/025
March 2007

Demonstration Evaluation of Biodegradable Degreaser

Appendix A.
MIL-PRF-87937D "Cleaning Compound, Aerospace Equipment"

Appendix B.
SMI Results from Eagle Kleen Analytical Testing

Appendix C.
SMI Results from Eagle Kleen II Analytical Testing

National Risk Management Research Laboratory
Office of Research and Development
U.S. Environmental Protection Agency
Cincinnati, OH 45268

Appendix A

MIL-PRF-87937D “Cleaning Compound, Aerospace Equipment”

INCH-POUND

MIL-PRF-87937D
24 September 2001
SUPERSEDING
MIL-PRF-87937C
14 August 1997

PERFORMANCE SPECIFICATION

CLEANING COMPOUND, AEROSPACE EQUIPMENT

This specification is approved for use by all
Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification establishes the requirements for biodegradable, water dilutable, environmentally safe cleaning compounds for use on aerospace equipment to include aircraft, aerospace ground equipment (AGE) and AGE engines.

1.2 Classification. The cleaning compounds covered by this specification will be of the following types.

Type I -Terpene Based, Solvent Emulsion, Water Dilutable Cleaning Compound

Type II -Water Dilutable Cleaning Compound

Type III -Gel-Type Cleaning Compound

Type IV -Heavy Duty, Water Dilutable Cleaning Compound

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this standard. This section does not include documents cited in other sections of this standard or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 4 and 5 of this standard, whether or not they are listed.

2.2 Government Documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards and handbooks form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents will be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Code (68) DET 3, WR-ALC/AFTT, BUILDING 1621-K, 2261 HUGHES AVE STE 123, LACKLAND AFB TX 78236-9823, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A
FSC 6850

SPECIFICATIONS

FEDERAL

A-A-58054	Abrasive Mats, Non-Woven, Non-Metallic
TT-I-735	Isopropyl Alcohol
TT-P-2760	Primer Coating, Polyurethane, Elastomeric, High-Solids.
PPP-P-704	Pails, Metal: (Shipping, Steel, 1 through 12 gallons)

DEPARTMENT OF DEFENSE

MIL-PRF-2104	Lubricating Oil, Internal Combustion Engine, Combat/Tactical Service
MIL-PRF-5425	Plastic, Sheet, Acrylic, Heat Resistant
MIL-C-5541	Chemical Conversion Coatings on Aluminum and Aluminum Alloys.
MIL-A-8625	Anodic Coatings, For Aluminum and Aluminum Alloys
MIL-G-21164	Grease, Molybdenum Disulfide, For Low and High Temperatures, NATO Code Number G-353
MIL-PRF-22750	Coating, Epoxy, High-Solids
MIL-PRF-23377	Primer Coatings: Epoxy, High-Solids.
MIL-PRF-25690	Plastic, Sheets And Formed Parts, Modified Acrylic Base, Monolithic, Crack Propagation Resistant
MIL-DTL-81381	Wire, Electric, Polyimide-Insulated, Copper or Copper Alloy
MIL-PRF-81733	Sealing and Coating Compound, Corrosion Inhibitive
MIL-PRF-83282	Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Aircraft, NATO Code Number H-537.
MIL-P-83310	Plastic Sheet, Polycarbonate, Transparent
MIL-DTL-83488	Coating, Aluminum, High Purity
MIL-PRF-85285	Coating: Polyurethane, High Solids
MIL-PRF-85582	Primer Coatings: Epoxy, Waterborne.

STANDARDS

FEDERAL

EPA-600-4-90-027	Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms
FED-STD-141	Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing
FED-STD-313	Material Safety Data Sheets, Preparation and the Submission of
FED-STD-595	Colors Used In Government Procurement

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issue should be that in effect on the date of the solicitation.

CODE OF FEDERAL REGULATIONS

40 CFR - Protection of Environment
49 CFR - Transportation

(Application for copies should be addressed to Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.)

2.3 Other publications. The following non-government documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted will be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS will be the issue of the non-government documents which is current on the date of the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM STANDARDS

A 153	Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware (DoD Adopted)
D 56	Test Method for Flash Point by Tag Closed Tester (DoD Adopted)
D 92	Test Method for Flash and Fire Points by Cleveland Open Cup (DoD Adopted)
D 93	Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester (DoD Adopted)
D 235	Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent) (DoD Adopted)
D 1193	Specification for Reagent Water (DoD Adopted)
D 2240	Test Method for Rubber Property - Durometer Hardness (DoD Adopted)
E 70	Test Method for pH of Aqueous Solutions with the Glass Electrode (DoD Adopted)
F 483	Test Method For Total Immersion Corrosion Test for Aircraft Maintenance Chemicals (DoD Adopted)
F 484	Test Method for Stress Crazing of Acrylic Plastics in Contact with Liquid or Semi-Liquid Compounds (DoD Adopted)
F 485	Test Method for Effects of Cleaners on Unpainted Aircraft Surfaces
F 502	Standard Test Method for Effects of Cleaning and Chemical Maintenance Materials on Painted Aircraft Surfaces.
F 519	Test Method for Mechanical Hydrogen Embrittlement Testing of Plating Processes and Aircraft Maintenance Chemicals
F 1104	Test Method for Preparing Aircraft Cleaning Compounds, Liquid Type, Water Base, for Storage Stability Testing
F 1110	Test Method for Sandwich Corrosion Test
F 1111	Test Method for Corrosion of Low-Embrittling Cadmium Plate by Aircraft Maintenance Chemicals

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken PA 19428-2959.)

SOCIETY OF AUTOMOTIVE ENGINEERS

SAE STANDARDS

AMS QQ-A-250	Aluminum and Aluminum Alloy, Plate and Sheet
AMS 1640	Corrosion Removing Compound, Prepaint, For Aircraft Aluminum Surfaces.
AMS 2410	Plating, Silver, Nickel Strike, High Bake
AMS M-3171	Magnesium Alloy, Processes for Pretreatment and Prevention of Corrosion on
AMS 3204	Rubber, Synthetic Low-Temperature Resistant 25-35 (DoD Adopted)
AMS 3209	Chloroprene (CR) Rubber, Weather Resistant, 65-75 (DoD Adopted)
AMS 4377	Sheet and Plate, Magnesium Alloy, 3.01A-1.0Zn-0.20Mn (AZ31B-H24) Cold Rolled, Partially Annealed (DoD Adopted)
AMS 5046	Sheet, Strip, and Plate, Carbon Steel (SAE 1020 and 1025) Annealed
AMS S-8802	Sealing Compound, Temperature-Resistant, Integral Fuel Tanks and Fuel Cell Cavities, High-Adhesion
AMS T-9046	Titanium and Titanium Alloy, Sheet, Strip and Plate

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale PA 15096.)

AMERICAN IRON AND STEEL INSTITUTE

AISI STANDARDS

AISI 4340 High Strength, Low Alloy Steel

(Application for copies should be addressed to American Iron and Steel Institute, 1133 15th St N.W. Suite 300, Washington DC 20005.)

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.4 Order of precedence. In the event of a conflict between the text of this specification and a reference cited herein, the text of this specification will take precedence.

3. REQUIREMENTS

3.1 Qualification.

3.1.1 Qualification (Initial). The cleaning compound furnished under this specification shall be a product which has been tested and has passed the qualification tests specified herein and has been listed or approved for listing on the applicable Qualified Products List (QPL).

3.1.2 Re-Qualification (Periodic). The cleaning compound furnished under this specification shall be retested or recertified by the qualifying activity at least every three years for the product to remain listed on the QPL. Re-Qualification testing shall be accomplished on any qualified cleaning compound for which a using activity issues a valid deficiency report. The cleaning compound shall also be subject to re-qualification testing for any change in chemical formulation, material, process, or procedure in manufacturing the cleaning compound. Upon periodic re-qualification, any cleaning compound which does not conform to all the qualification tests specified herein shall be removed from the QPL.

3.1.3 Qualifying activity. The activity responsible for specification qualification and the QPL is the Air Force Petroleum Office, Product Engineering Branch, San Antonio TX. Activity mailing address is: DET 3 WR-ALC/AFTT, BUILDING 1621-K, 2261 HUGHES AVE STE 123, LACKLAND AFB TX 78236-9823.

3.2 Materials. The composition and formulation of the cleaning compound shall be optional with the manufacturer within the restrictions specified herein.

3.2.1 Acceptable materials.

3.2.1.1 Type I. Type I compounds shall contain terpene hydrocarbons as specified in Table I. Certification from the manufacturer is required on the percentage of total terpenes contained in the cleaning compound. The terpene hydrocarbons used shall be of a high grade with no extraneous materials.

3.2.1.2 Type II, Type III, and Type IV. Types II, III, and IV compounds shall consist of one or more of the following: Surfactants, adjuvant solubilizers for organic soils such as greases and oils, alkaline builders, water conditioning agents and corrosion inhibitors.

3.2.2 Unacceptable materials. The cleaning compound shall not contain any hazardous compounds as defined in 40 CFR 261, toxic pollutants in 40 CFR 301, nor hazardous air pollutants in 40 CFR 63 (see 4.6). The cleaning compound shall not contain any chemical listed by the current report of known carcinogens of the National Toxicology Program (NTP). The cleaning compound shall not contain detectable amounts of any of the following: abrasives, chromates, cadmium, lead, mercury, phenols,

cresols, ketones, chlorinated compounds or ozone depleting substances (ODS), except where specified within this specification. The following materials are unacceptable unless they are being used as an essential active ingredient in the cleaner: sodium chloride, urea, sodium sulfate, nitrites, nitrates, sucrose or any sugars. Types II, III, and IV compounds shall contain no terpene hydrocarbons or other hydrocarbon solvents.

3.3 Toxicity. The cleaning compound shall have no adverse effect on the health of personnel or the environment when used for its intended purpose and with proper personal protective equipment (when required). The product shall be evaluated for aquatic toxicity with a 96 hour Fathead minnow (pimephales promelas) bioassay and a 48 hour Ceriodaphnia dubia bioassay in accordance with Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, EPA/600/4-90/027. The percent survival at 1, 10, 50, and 100 ppm shall be reported for both organisms.

3.3.1 Formulation. The manufacturer shall submit to the qualifying activity a certified statement that provides the identity and percentage by weight of each ingredient in the cleaning compound, including solvent, using a readily recognizable chemical name and CAS number. Trade names alone shall not be considered satisfactory. All proprietary information shall be protected as such.

3.3.1.1 Type I. The manufacturer shall submit to the qualifying activity the chemical name of each terpene used in the formulation including its CAS number and range of values in percent by weight of the formulation. The manufacturer shall also submit test procedures used to verify the terpene percentages within these ranges. All procedures shall be subject to approval by the qualifying activity.

3.3.2 Material safety data sheet (MSDS). The manufacturer shall submit to the qualifying activity an MSDS for the finished product and for each component in the finished product. The MSDS shall be prepared in a 16 part format in accordance with the latest revision of FED-STD-313.

3.3.3 Toxicological data. The manufacturer shall submit to the qualifying activity a copy of pertinent toxicological data/information (see 4.6) for their product.

3.3.4 Biodegradability. The supplier of the cleaning compound shall furnish certification from the surfactant manufacturers that the surfactants are readily biodegradable in accordance with 40 CFR, Part 796, Subpart D. Biodegradability testing shall be accomplished as specified in paragraph 4.5.22 on the finished product by an independent laboratory approved by the qualifying activity. Biodegradability on the finished product shall be determined over 28 days by the Shake Flask Method monitored by analysis of Total Organic Carbon (TOC). The Type I compound shall meet the requirement of a minimum of 75% biodegradable and Types II, III, and IV compounds shall meet the requirement of a minimum of 85% biodegradable at the end of the 28 day period.

3.4 Compositional assurance. The cleaning compound shall be tested for nonvolatile matter as specified in paragraph 4.5.1. The concentrated cleaning compound and a 10% solution of the cleaning compound in distilled water shall be tested for pH as specified in paragraph 4.5.3. Results of these tests as well as an infrared spectrogram of the nonvolatile matter (see 4.8.2) and a gas chromatogram (see 4.8.1 for Type I only) shall be recorded by the qualifying activity for use in conformance inspections (see 4.3). Conformance inspection results for nonvolatile matter shall not differ by more than 2 percent absolute from the recorded value. Conformance inspection results for pH shall not differ by more than 1 pH unit from the recorded value. Conformance inspection infrared spectrograms and gas chromatograms shall show no significant difference when compared to the original qualifying spectrogram.

3.5 Chemical properties.

3.5.1 Chemical requirements. The cleaning compound shall meet the requirements listed in Table I.

3.5.2 Residue rinsibility. When a freshly prepared solution of the cleaning compound is tested in accordance with 4.5.4, it shall not leave any residue or stains. A freshly prepared solution is defined as one being prepared no longer than 30 minutes prior to testing. The weight change shall be not greater than that obtained with standard hard water tested under the same conditions.

3.6 Physical properties (All types unless otherwise noted).

3.6.1 Heat stability. The concentrated cleaning compound, when tested in accordance with 4.5.5, shall show no marked color change or precipitation and shall not corrode or stain the AMS 5046 (SAE 1020) steel strip (a slight darkening of the steel strip shall not be objectionable). Layering or separation shall constitute failure if it does not return to its original homogeneous state upon cooling.

3.6.2 Cold stability. The concentrated cleaning compound shall return to its original homogeneous condition when tested in accordance with 4.5.6.

3.6.3 Rheology (Type III only).

3.6.3.1 Consistency. When tested as specified in 4.5.24, the concentrated cleaning compound shall flow between 10 and 20 centimeters in 10 seconds. The product shall also exhibit rheology which enables it to meet the sprayability requirement.

3.6.3.2 Sprayability. The concentrated cleaning compound, when dispensed at 45 psig and tested in accordance with 4.5.25, shall give satisfactory spray characteristics and deposit a uniform layer on a vertical surface 3 feet away from the nozzle.

3.7 Effect on metals (All types unless otherwise noted).

3.7.1 Hydrogen embrittlement. When tested in accordance with 4.5.9, the concentrated cleaner (all types) and a 10% solution of the cleaner (Types I, II and IV only) in distilled water shall not cause hydrogen embrittlement of cadmium plated or IVD aluminum coated AISI 4340 steel.

3.7.2 Total immersion corrosion. When tested in accordance with 4.5.10 (ASTM F 483), the concentrated cleaning compound (all types) and a 10% solution of the cleaning compound (Types I, II and IV only) in distilled water shall not show any indication of staining, etching, pitting, or localized attack on any of the panels, or cause a weight change of an average of three (3) test panels greater than that shown in Table II. A slight discoloration of the panels shall not be objectionable. The cleaning compound shall not layer or separate for the duration of the test.

3.7.3 Low-embrittling cadmium plate corrosion. Steel panels coated with low-embrittling cadmium plate immersed in the concentrated cleaning compound (all types) and a 10% solution of the cleaning compound (Types I, II and IV only) in distilled water shall not show a weight change greater than 0.14 mg/cm^2 for 24 hours when tested in accordance with 4.5.11.

3.7.4 Effects on unpainted metal surfaces. The concentrated cleaning compound (Type III only) and a 10% solution (Types I, II and IV) of the cleaning compound in distilled water shall not cause streaking, stains or other deposits that cannot be easily removed with water when tested in accordance with 4.5.12.

3.7.5 Sandwich corrosion. When tested in accordance with 4.5.16, the concentrated cleaner (all types) and a 10% solution (Types I, II and IV only) shall show no corrosion in excess of that shown by control test coupons in ASTM D1193, Type IV, reagent water.

3.7.6 Wet adhesion tape test (Types II and IV). A ten (10) percent solution of the cleaning compound, when used as directed, shall remove soil from a painted surface in preparation for repainting such that paint applied after cleaning with the compound shall adhere to the surface when tested in accordance with 4.5.27.

3.8 Effect on painted surfaces. The concentrated cleaning compound (Type III only) and a 25% solution (Types I, II, and IV) of the cleaning compound in distilled water shall not cause streaking, blistering, discoloration or a permanent decrease in film hardness of more than one (1) pencil hardness level when

tested in accordance with 4.5.13. The Type I material shall be tested using only the Polyurethane Paint Systems (H).

3.9 Stress crazing of MIL-PRF-5425 and MIL-PRF-25690 (Type A and C) acrylic plastics. The concentrated product (Type III only) and a 10% solution (Types I, II and IV) in distilled water shall not cause stress crazing or staining of acrylic plastics when tested in accordance with 4.5.14.

3.10 Stress crazing of polycarbonate plastic. The concentrated product (Type III only) and a 10% solution (Types I, II and IV) in distilled water shall not cause stress crazing or staining of polycarbonate plastic conforming to MIL-P-83310 when tested in accordance with 4.5.15.

3.11 Long term storage stability. After being stored for a period of 12 months, in accordance with 4.5.17, the cleaning compound shall not layer, separate, precipitate or corrode the shipping container. Plastic containers shall not show leakage nor any cracking, crazing, or softening. All cleaning compounds shall meet the requirements of paragraphs 3.5.1, 3.7.1, 3.7.2, 3.15, and 3.16 of this specification.

3.12 Hot dip galvanizing corrosion. The concentrated product (Type III only) and a 10% solution of the cleaning compound (Types I, II and IV) in distilled water shall not show a weight change of an average of three (3) test panels greater than 0.14 mg/cm² when tested in accordance with 4.5.18.

3.13 Workmanship. The cleaning compound shall be a liquid having a uniform and homogenous appearance. The cleaning compound shall be manufactured from materials that shall produce a product harmless to metal surfaces and humans when used as directed.

3.14 Effect on polysulfide sealants. The concentrated cleaning compound (Type III only) and a 25% solution (Types I, II and IV) of the cleaning compound in distilled water shall not change the durometer hardness of the polysulfide sealant by more than 5 units when tested in accordance with 4.5.19.

3.15 Rubber compatibility. The concentrated cleaning compound (Type III only) and a 25% solution (Types I, II and IV) of the cleaning compound in distilled water shall not change the durometer hardness more than 5 units when tested in accordance with 4.5.20.

3.16 Effect on polyimide insulated wire. The cleaning compound, when tested according to 4.5.26, shall not cause dissolution, cracking, or dielectric breakdown (leakage) of the polyimide insulated wire in excess of that produced by distilled water.

4. VERIFICATION

4.1 Classification of tests. The inspection and testing of the cleaning compound shall be as follows.

a. Qualification inspection (4.2).

b. Conformance inspection (4.3).

4.2 Qualification inspection. Qualification inspection shall consist of all inspections and tests specified herein.

4.2.1 Qualification samples. The initial qualification samples shall consist of 12 liters (3 gallons) of the cleaning compound. The cleaning compound shall be furnished in containers of the type to be used in filling contract orders. Samples shall be identified as follows and forwarded to the laboratory responsible for testing, as designated in the letter of authorization from the qualifying activity (see 3.1.3):

- Samples for Qualification Tests.
- Cleaning Compound, Aerospace Equipment, (Types I, II, III, and IV).
- MIL-PRF-87937D.
- (Manufacturers Product and Code Number)

- (Name and Address of Contractor)
- Submitted by (Name), (Date) for Qualification Testing in Accordance with the Requirements of MIL-PRF-87937D Under Authorization (Reference Authority Letter).
- (Mixing and Other Important Instructions.)
- (Safety Information and Precautions.)

4.2.2 Test reports. The contractor shall provide certified test reports showing that the material conforms to all the requirements of this specification. The initial report consisting of all specification requirements except the storage stability tests shall be provided upon completion of those tests. The final report shall be provided after the completion of the storage stability tests and shall consist of those test results. Certified test reports shall include the gas chromatogram (4.8.1) or the infrared spectrogram (4.8.2) as required.

4.2.3 Qualification required. Prior to actual procurement, the cleaning compound shall pass the qualification inspections and requirements specified herein. If the product is later modified in any way, the modified form shall be subjected to and shall pass the same qualification inspections (see 3.1). Any changes or modifications from the formulation used at the initial qualification shall be approved by the qualifying activity and may require re-qualification. All initial qualifications shall be granted contingent upon compliance with the long term storage stability requirement specified in paragraph 3.11.

4.3 Conformance tests. Conformance tests (see 6.5) for acceptance of the cleaning compound shall consist of the following tests.

A.	Workmanship
B.	Cold Stability
C.	Insoluble Matter
D.	Consistency (Type III only)
E.	Immersion Corrosion*
F.	Emulsion Characteristics
G.	Nonvolatile Matter
H.	pH
I.	Flash Point
J.	Infrared Spectrogram (Types II, III and IV)
K.	Gas Chromatogram (Type I only)

*Immersion Corrosion Conformance Test ran on Aluminum SAE AMS-QQ-A-250/4, Bare T3 alloy panel only.

If during conformance testing a lot fails any of the above acceptance tests, all tests required for qualification shall be reinstituted. These qualification tests shall be required until two successive lots meet all requirements of the specification, after which conformance testing shall again be authorized (see 4.3.5).

4.3.1 Sampling. Unless otherwise specified, not less than a 3.8 liter (1 gal) container of the cleaning compound shall be selected at random from each lot and subjected to the tests specified in 4.3. The contents of each selected container for sampling shall be thoroughly mixed by rolling and inverting immediately prior to sampling.

4.3.2 Lot. A lot shall consist of one of the following:

a. The cleaning compound produced in not more than 24 consecutive hours from a continuous process which is used to fill shipping containers directly from the process output. A continuous process shall be the production of product by continuous input of raw materials and output of finished product by one manufacturer in one plant with no change in manufacturing conditions or materials.

b. The cleaning compound from individual runs of a batch process which is used to fill shipping containers directly from the process output. A batch process shall be the production of product by runs from single additions of raw materials which are mixed, reacted, or purified forming the product.

c. The cleaning compound from either or both the continuous and batch processes which is held in a single storage tank and subsequently withdrawn to fill shipping containers. The product shall be homogeneous at the time of withdrawal and shall not be added to while being withdrawn. After each addition to the storage tank, the contents shall constitute a separate lot.

4.3.3 Sampling of product. Unless otherwise specified, conformance tests (4.3) shall be made on the sample of product taken directly from the filled containers. The number of filled containers selected for sampling from each lot shall be in accordance with Table III. The first and last containers to be filled within a given lot shall be sampled. Other containers shall be selected at random. The samples may be obtained in any convenient manner that does not compromise the integrity of the sample.

4.3.4 Inspection of materials. The contractor is responsible for ensuring that materials and components used are manufactured, tested and inspected in accordance with the requirements of referenced subsidiary specifications and standards to the extent specified, or, if none, in accordance with this specification. (see 2.3)

4.3.5 Rejection and retest. When any sample of the product examined and tested in accordance with this specification fails to conform to the requirements specified herein, the entire lot represented by the sample shall be rejected. Rejected material shall not be resubmitted for acceptance without prior approval of the qualifying activity. The application for resubmission shall contain full particulars concerning previous rejections and all measures taken to correct those defects. Samples for retest shall be taken only from a sealed container.

4.4 Testing standards. All laboratory tests shall be conducted at standard conditions unless otherwise specified herein. Standard conditions are defined by FED-STD-141, Section 9. Unless otherwise specified, all chemical tests shall be made with ACS specification reagent grade chemicals. Unless otherwise specified, all product dilutions shall be made with distilled water which conforms to the requirements of ASTM D 1193, Type IV, reagent water. The term "concentrated" cleaner or compound refers to that concentration of the cleaner/compound as received from the manufacturer. No further concentration shall be performed on the product.

4.5 Test methods.

4.5.1 Nonvolatile matter. Weigh 5.00 ± 0.01 g of the sample in a porcelain or glass dish about 6 to 8 cm in diameter and about 2 to 4 cm in depth. Dry to constant weight in an air oven at a temperature of 105 ± 2°C. Constant weight is attained when successive heating for 1-hour periods shows a loss (or gain) of not more than 0.1%. Nonvolatile matter determinations shall be made on a minimum of two samples and the average shall be reported. If the two weights differ by more than 0.5% (absolute) the procedure shall be repeated. The nonvolatile content of each sample shall be calculated as follows:

$$\%\ NVM = \left[\frac{A}{B}\right] 100$$

Where: A = Weight of residue
B = Weight of sample
$\%\ NVM$ = Percent nonvolatile matter

4.5.2 Insoluble matter. The concentrated cleaning compound shall be thoroughly agitated and a 200 ml test sample withdrawn. The insoluble matter shall be collected with the aid of a vacuum filtering apparatus consisting of a water tap filter pump, a 2,000 ml Erlenmeyer flask, a size 4 (126 mm ID) Buchner funnel and a piece of 126 mm diameter Whatman No 5 filter paper, or equivalent. The filter paper shall be dried at 60°C (140°F) for 30 minutes in a gravity convection oven, cooled for 3 minutes in a desiccator, and weighed to the nearest 0.1 mg. The filter paper shall be placed in the Buchner funnel so that its

circumference coincides with the circumference of the funnel. The vacuum shall be started and the filter paper wetted with approximately 10 ml of distilled water in order to secure it properly in place. The test sample shall be filtered. The sides of the beaker which contained the test sample shall be rinsed with 25 ml of distilled water from a wash bottle, and the rinse transferred to the funnel, insuring that any remaining insoluble matter is completely transferred with the rinse. When all the initial liquid and the rinse have been transferred through the filter, the sides of the funnel shall be washed with 25 ml of distilled water from a wash bottle and the rinse allowed to filter. The vacuum on the flask shall be relieved and the filter paper removed from the funnel. The filter paper shall be dried for 1 hour at 60°C (140°F) in a gravity convection oven, cooled for 3 minutes in a desiccator, and weighed to the nearest 0.1 mg. The percent insolubles shall be calculated as follows:

$$I = \left[\frac{A - B}{W} \right] 100$$

Where: A = Final filter paper weight
B = Initial filter paper weight
W = Weight of sample
I = % Weight insoluble matter

Care should be exercised throughout the final drying and weighing cycle to maintain the flat surface of the filter paper in a horizontal position so that none of the insoluble matter will be lost. Insoluble matter determinations shall be made on a minimum of two samples and the average shall be reported. If the two results differ by more than 0.5% (absolute) the procedure shall be repeated.

4.5.3 pH value. The pH value of the concentrated cleaning compound and a 10 percent solution of the cleaning compound in freshly boiled distilled water shall be measured in accordance with ASTM E 70.

4.5.4 Residue rinsibility. Six smooth aluminum dishes, containing no creases or crevices, shall be cleaned in a solution of Brite-Boy, (from 3D Inc., or equivalent), rinsed, and dried to constant weight. Ten ml of a 25% by volume solution of the cleaning compound in standard hard water (see 4.5.4.1) shall be placed in three of the precleaned dishes and tested according to the procedure in 4.5.4.2.

4.5.4.1 Preparation of standard hard water. A 20-grain (as $CaCO_3$) hard-water stock solution shall be prepared by dissolving 0.40 ± 0.005 g of reagent grade Calcium Acetate, $Ca(C_2H_3O_2)_2 \cdot 2H_2O$ and 0.28 ± 0.005 g of reagent grade Magnesium Sulfate, $MgSO_4 \cdot 7H_2O$, in 1 liter of boiled distilled water.

4.5.4.2 Procedure. Dry three dishes each containing 10.0 ml of a 25% cleaning solution for 7 1/2 hours in a circulating oven at 68 ± 2 °C with full draft. Cool in desiccator overnight and weigh. Rinse with running distilled water for 1 minute. Brush with a sash-type brush containing long-fiber bristles (2.5 cm diameter by 3.8 cm to 6.4 cm long) for 1 minute using distilled water. Rinse for 30 seconds with running distilled water. Dry in oven as before, cool and reweigh. Standard hard water (4.5.4.1) shall be tested as control for weight change comparison in the remaining three precleaned dishes, using the same procedure as above.

4.5.5 Heat stability. A 141.75 g sample of the well mixed concentrated cleaning compound shall be placed into each of two clean 255 ml (12 oz) clear glass bottles having approximate dimensions of 24 cm in height by 6.35 cm in diameter (9.5 in x 2.5 in). One bottle containing the concentrated cleaning compound shall be sealed with a screw type cap and stored in a dark place at standard conditions for 6 days (144 hrs) for reference purposes. Place into the second bottle of concentrated cleaning compound a strip of steel, 15.24 cm by 1.27 cm by 0.05 cm (6 in x 0.5 in x 0.02 in) conforming to AMS 5046 (SAE 1020). Clean the steel strip by abrasively polishing to remove surface scale and corrosion followed by immersion for one minute in ASTM D 235 Mineral Spirits or equivalent followed by immersion for one minute in isopropyl alcohol (TT-I-735, grade A) at standard conditions. Wipe test panels with an alcohol wetted lint free cloth and dry with a clean, lint free cloth. Oven drying is optional. Seal the bottle containing the concentrated cleaning compound and the cleaned steel strip with a screw type cover and shake thoroughly for 1 minute. Place the bottle in a bath maintained at 46 ± 2 °C (115 ± 3 °F) for 5 hours,

then remove and allow to cool to ambient conditions for 19 hours. This heating/cooling cycle shall be repeated 5 times. After completion of the test period, remove the test strip and inspect the portion of the strip which was immersed in the cleaning compound and the portion exposed to the vapor. Any corrosion, pitting or discoloration constitutes failure. The bottle is resealed and along with the control bottle that has been maintained in the dark is shaken thoroughly for 1 minute, then allowed to remain undisturbed for 1 hour at room temperature. The bottles are then examined. Any marked change in color, precipitation, layering or separation constitutes failure.

4.5.6 Cold stability. A 50 ml sample of the cleaning compound shall be poured into a test tube and cooled to 0°C. This temperature shall be maintained for one hour. The compound shall then be allowed to reach room temperature. After 5 (five) complete temperature inversion cycles of the test tube, the compound shall be examined for homogeneity. A slight turbidity shall not be objectionable provided no precipitation is present.

4.5.7 Flash point. The flash point of the concentrated cleaning compound (Type I, II, III, and IV) shall be determined in accordance with ASTM D 56 (Tag Closed Cup) and for materials that have a tendency to form a surface film under the test conditions, use ASTM D 93. The flash point of the 10% solution in distilled water (Type I only) shall be determined in accordance with ASTM D 92.

4.5.8 Emulsion characteristics. Twenty ml of a 25% by volume solution (Types I and II) of the cleaning compound (12.5% by volume solution for Types III and IV) shall be placed in a 50 ml glass stoppered graduated cylinder. Twenty ml of lubricating oil conforming to MIL-PRF-2104, grade 10W, shall be added. An emulsion shall be formed by 10 inversions of the graduated cylinder followed by a vigorous 15 second shake. After the emulsion has stood for 5 minutes, the 15 second shake shall be repeated. At 5 minutes and 8 hours for Type I and at 5 minutes and 24 hours for Types II, III and IV cleaners, the amount of free water and cleaner which separates from the lubricating oil shall conform to the requirements of Table I.

4.5.9 Hydrogen embrittlement. The hydrogen embrittlement properties of the cleaning compound shall be determined as passive chemicals in a service environment according to ASTM F 519 using two (2) sets of either Type 1a, 1c, or 2a AISI 4340 steel specimens. One set shall be plated per Table 2 Treatment B, ASTM F 519. The second set shall be coated with Ion Vapor Deposited (IVD) Aluminum per MIL-DTL-83488D, Class 2, Type I. Prior to coating, specimens for IVD Aluminum shall be prepared by grit blasting, including notched area, with size 180 virgin grain white aluminum oxide grit. The applied IVD coating shall not be peened or burnished in any manner. All specimens must be completely plated or coated except for the screw threads.

4.5.10 Total immersion corrosion. The total immersion corrosion effects of the cleaning compound on the new, unused metals and metal alloys listed in Table II shall be determined in accordance with ASTM F 483. After immersion for 24 hours and after 168 hours, panels shall be evaluated for appearance. Conformance to the requirements in Table II shall be for weight loss after 168 hours. In order to obtain the best results on test panels in this very low weight category, the panels shall be handled with gloves, cleaned in a very careful manner and dried in an oven. They are cooled and dried in a desiccator both before and after each weighing.

4.5.11 Low-embrittling cadmium plate corrosion. The cleaning compound shall be evaluated for corrosion on low-embrittling cadmium plate in accordance with ASTM F 1111.

4.5.12 Effects on unpainted metal surfaces. The cleaning compound shall be evaluated for effects on unpainted metal surfaces in accordance with ASTM F 485.

4.5.13 Effect on painted surfaces. The concentrated cleaning compound (Type III only) and a 25% solution (Types I, II and IV) with distilled water shall be tested in accordance with ASTM F 502 except that the panels used for testing shall be coated with the paint systems listed in Table IV. For all paint systems tested, a separate panel shall be required for both 25% solution and concentrate. For Types II, III and IV compounds, conduct the test on all paint systems listed in Table IV. For Type I compounds, conduct the test only on the polyurethane paint systems (H).

4.5.14 Stress crazing of MIL-PRF-5425 and MIL-PRF-25690 (Type A and C) acrylic plastics. The cleaning compound shall be evaluated for stress crazing of stretch (Type A and C) acrylic plastics in accordance with ASTM F 484.

4.5.15 Stress crazing of polycarbonate plastic. The cleaning compound shall be evaluated for stress crazing of polycarbonate plastics using the test procedure outlined in ASTM F 484 with the exception that the acrylic plastics called for in the procedure be replaced with polycarbonate plastic conforming to MIL-P-83310 of the same dimensions and the polycarbonate specimens shall be stressed for 30 ± 2 minutes to an outer fiber stress of 2000 psi.

4.5.16 Sandwich corrosion. The cleaning compound shall be tested in accordance with ASTM F 1110 as specified in paragraph 3.7.5.

4.5.17 Long term storage stability. The cleaning compound shall be prepared and stored for long term storage stability in accordance with ASTM F 1104 using one (1) 3.8 liter (one-gallon) can conforming to Federal Specification PPP-P-704 or DOT UN 1A1 steel container. Plastic containers shall conform to DOT UN 1H1 as required by 49 CFR 178. Manufacturers using both type materials in production packaging shall test each type container with their product.

4.5.18 Hot dip galvanizing corrosion. The total immersion corrosion effect of the cleaning compound shall be evaluated as specified in 3.12 after 24 hour immersion per ASTM F 483. Test coupons shall be AMS 5046 (SAE 1020) steel panels prepared by hot dip galvanizing per ASTM A 153.

4.5.19 Effects on polysulfide sealant.

4.5.19.1 Preparation of test specimens. MIL-PRF-81733, Type I, and SAE AMS S-8802 sealants shall be mixed as specified by their respective manufacturers and each pressed into a 1/8 inch thick sheet mold until cured (this shall be the sheet stock for each sealant). The sealants shall be cured for 7 days at 49°C. The specimens shall be cut from the sheet stock.

4.5.19.2 Test procedures. Immerse two specimens of each sealant in the concentrated product (Type III only) and a 25% solution of the cleaning compound (Types I, II and IV) at room temperature for 30 minutes. Remove from the solution, rinse with cool tap water, and test within 30 minutes for Shore A hardness in accordance with ASTM D 2240.

4.5.20 Test on rubber compatibility. Tests shall be conducted on AMS 3204 and AMS 3209 rubbers for compatibility with the cleaning compounds.

4.5.20.1 Preparation of test specimens. Three (3) test specimens shall be used for each type rubber specified. Test specimens shall be cut from 1/8 inch sheet stock.

4.5.20.2 Test procedure. Test and record the Shore A hardness of each test specimen in accordance with ASTM D 2240. Immerse each specimen in the concentrated product (Type III only) and a 25% solution of the cleaning compound (Types I, II and IV) at room temperature for 30 minutes. Remove from the solution, rinse with cool tap water, and test within 30 minutes for a Shore A hardness in accordance with ASTM D 2240.

4.5.21 Cleaning efficiency (all types). The cleaning efficiency of the cleaning compound shall be reported as the average of three test results and shall conform to the requirements of Table I.

4.5.21.1 Preparation of control formula. The control formula shall be prepared by the testing laboratory in accordance with Table V and subjected to the cleaning test (4.5.21.5) and evaluation (4.5.21.6). Valid control formula preparations shall produce denominator values greater than 0.95 during testing.

4.5.21.2 Panel preparation. Aluminum SAE AMS QQ-A-250/4, bare T3 panels, 40.6 x 12.7 x 0.05 cm (16 x 5 x .02 in) shall be used.

4.5.21.3 Soil preparation. Molybdenum disulfide grease soil shall be prepared by blending 50 grams of carbon black and 500 grams MIL-G-21164 grease with a mechanical grease worker for 15 minutes.

4.5.21.4 Application of grease soil. Panels shall be wiped with clean lint free cloths soaked in reagent grade acetone then dried to a constant weight. Record the weight to the nearest 0.1 mg. Apply approximately 200 mg grease soil using a soft bristle brush over an area approximately 2" x 7" in the center of the panel. Remove excess grease soil by covering the test panel with a folded absorbent tissue and exerting pressure by rolling a five pound rubber cylinder over the tissue. Repeat this blotting procedure twice. Each freshly soiled panel shall be baked at 105 ± 5 °C for 60 minutes then cooled to room temperature and weighed to the nearest 0.1 mg. Only use panels with more than 50 mg of grease soil. Panels shall be used within 4 hours.

4.5.21.5 Cleaning test. The test panels shall be cleaned using a Gardner heavy duty wear tester, or equivalent, fitted with a cellulose sponge. The sponge shall be cut such that the dimension parallel to the cleaning stroke is 9 cm (3.5 in) and the width is 7 cm (2.75 in). The cleaning head with the dry sponge attached shall be weighed to a mass of 495 to 505 grams. The cleaning stroke of the scrub tester shall be 12 inches. The cleaning compound (including Type III) and the control formula shall be diluted 1 part cleaner with 9 parts distilled water. After placing a soiled test panel in the template 100 ml of the cleaning solution shall be applied to the sponge then applied to the soiled test panel so that it is completely covered. After allowing a 30 seconds dwell time, the test panel shall be cleaned using 5 cycles of the wear tester. The panel shall then be rinsed with sufficient amounts of distilled water.

4.5.21.6 Evaluation. The rinsed panel shall be heated to 105°C ± 5°C for 10 minutes, cooled to room temperature, then weigh to the nearest 0.1 mg. Report the % Cleaning Efficiency as the average of three (3) tests using the following:

$$\%\ \text{Cleaning Efficiency} = \frac{\left[\frac{A-B}{A-C}\right]}{\left[\frac{X-Y}{X-Z}\right]} \times 100$$

where: A = Weight of the soiled panel before cleaning with product
B = Weight of the soiled panel after cleaning with product
C = Weight of the unsoiled panel used in the product cleaning test
X = Weight of the soiled panel before cleaning with the control formula
Y = Weight of the soiled panel after cleaning with the control formula
Z = Weight of the unsoiled panel used in the control formula cleaning test

4.5.22 Biodegradability. Biodegradation shall be determined by the "Shake Flask Biodegradation Tests" for measuring ultimate or ready degradation potential, as found in EPA Chemical Fate Test Guidelines 40 CFR Method 796.3100 (Aerobic Aquatic Biodegradation Test) or 40 CFR Method 796.3240 (OECD Screening Test for Ready Biodegradability). Biodegradability shall be shown as carbon transformation by both soluble organic carbon reduction and CO_2 evolution.

4.5.23 Terpene hydrocarbons (Type I only). An approved test procedure shall be used (see 3.3.1.1).

4.5.24 Consistency (Type III only). A consistometer (Central Scientific Company, Chicago, IL; Catalog No. 24925 or equivalent) shall be used as follows: Shake the container of cleaning compound by hand for 10 seconds. Pour the material into the well of the consistometer completely filling it. Release the gate and determine the extent of flow in ten seconds.

4.5.25 Sprayability (Type III only). Fill the reservoir of the application test equipment with Type III compound, as supplied. Release the compound flow valve and gradually increase the nozzle tip pressure to not more than 8 psi pressure observing the discharge spray characteristics. Report the following:

a. The maximum pressure at which no bubbles are released into the surrounding air.

b. The distance the gel can be satisfactorily projected.

4.5.25.1 Technique. Under these optimized conditions apply with a sideways sweeping motion the compound to a vertical surface and examine the deposited film and record assessment. The product should display uniformity with absence of large and entrained air bubbles or a consistency which would not inhibit effective cleaning.

4.5.25.2 Application test equipment.

a. Reservoir: Hand pump pressure sprayer (modified), or pressure pot with air pressure applied from external compressor.

b. Nozzle: Fan jet with an equivalent orifice diameter 1.1 mm and spray angle 65°. (Spraying Systems Co., Wheaton Illinois, Item Number H-VV 6503)

4.5.26 Effect on polyimide insulated wire. Coil two segments of MIL-DTL-81381/11-20 wire approximately 61 cm (24 in) and place into separate 118 ml (4 oz) wide mouth jars. To one jar add sufficient concentrate cleaning compound to completely cover the wire coil. To the other jar (control sample) add sufficient distilled water to cover the wire coil. Cap both jars and store at room temperature (20 - 25 °C) for 14 days. At the end of the storage period remove both coils, rinse thoroughly with distilled water and suspend to allow complete draining and drying. Uncoil the wires, examine each closely for dissolution, and report the results. The wire immersed in the cleaner shall perform as well as the wire immersed in distilled water. Both wires shall then be subjected to a double reverse wrap on a 0.3 cm (0.125 in) mandrel and examined for cracking. (Note: Failure of the control sample here voids the test and shall be repeated using new MIL-DTL-81381/11-20 material). Wire immersed in the cleaner shall then be examined for cracking. If cracking occurs results shall be reported and the test ended. Passing wire shall then withstand a one minute dielectric test of 2,500 volts (rms), using a Hypot model number 4045 or equivalent, and examined for breakdown or leakage. Wire immersed in the cleaner shall perform equally well as the control wire immersed in distilled water.

4.5.27 Wet adhesion tape test. This method tests the coating to metal and the intercoat adhesion of an organic coating system. This procedure is used to determine the cleanliness of the surface prior to coating.

4.5.27.1 Preparing test coupons. The test coupons shall consist of nine (9) 4 in x 6 in aluminum alloy coupons conforming to SAE AMS QQ-A-250/12. The coupons shall be cleaned with reagent grade acetone, then cleaned with the diluted cleaning compound (10% solution) agitated for 20 seconds with a Scotch Bright pad (A-A-58054, Type I Class 1, Grade B, maroon color) and thoroughly rinsed with water and allowed to dry. Pretreat the coupons with AMS 1640 and MIL-C-5541. The coupons shall be air dried and primed with MIL-PRF-23377, Type I Class C high solids epoxy primer. Topcoat the coupons according to Table VI as follows:

Set 1: Six coupons (Code A plus D)
Primer: MIL-PRF-23377, Type I, Class C High-Solids Epoxy
Topcoat: MIL-PRF-85285, Type I High Solids Polyurethane Color # 34092

Set 2: Three coupons (Code A plus D)
Primer: MIL-PRF-23377, Type I, Class C High-Solids Epoxy
Topcoat: MIL-PRF-85285, Type I High Solids Polyurethane Color # 17925.

The coatings should be allowed to cure for a minimum of seven (7) days before being validated by performing the wet tape test.

4.5.27.2 Coupon validation procedure. The nine coupons (two sets in 4.5.27.1) shall be validated using the following wet tape test.

a. Immerse the test coupons in distilled water for 24 hours.

b. Remove the test coupons from the water and wipe dry with a clean lint free cloth.

c. Immediately apply a 25.4 mm wide strip of Masking Tape (3M Co., Code No. 250) with the adhesive side down. Do not apply the tape within 1/2 inch of any edge.

d. Press the tape against the surface of the coating by passing a 2.0 kg rubber covered roller, having a surface Durometer hardness value of 70 to 80, across the tape eight times.

e. Remove the tape with one quick motion and examine for damage to the intercoat or surface adhesion.

f. If there is no damage to the surface, note and proceed to 4.5.27.3. If three or more coupons fail the wet tape test or there is any unusual or non-typical condition, investigate to determine if use of cleaner contributed to failure or unusual condition. Report findings. Failed coupons or coupons with unusual surface conditions shall not be validated nor used in the repaint testing of Section 4.5.27.3.

4.5.27.3 Test procedure. This test shall verify the cleaning compound's effectiveness to remove soil from a painted surface in preparation for repainting (touch up). Immerse the coupons validated in 4.5.27.2 in hydraulic fluid conforming to MIL-PRF-83282 for ten (10) minutes. Remove the panels from the fluid and blot excess fluid from the coupons with a paper napkin. Spray the diluted cleaning compound (10% solution) on the coupons, agitate for 20 seconds with a 3M Scotch Bright Pad (A-A-58054) and thoroughly rinse with clean water. After the coupons have air dried, recoat the panels from Table VI as follows:

Set 1: Three coupons (code B plus D)
Primer: MIL-PRF-85582, Type I, Class 1B Waterborne Epoxy
Topcoat: MIL-PRF-85285 Type I High Solids Polyurethane, Color #34092

Set 2: Three coupons (Code A plus D)
Primer: MIL-PRF-23377, Type I, Class C High Solids Epoxy
Topcoat: MIL-PRF-85285 Type I High Solids Polyurethane, Color # 34092

Set 3: Three coupons (Code C plus D)
Primer: TT-P-2760, Type I, Class C High Solids Elastomeric, Polyurethane
Topcoat: MIL-PRF-85285 Type I High Solids Polyurethane, Color # 34092

After the above coatings have air dried for seven (7) days, perform the Wet Tape Test in paragraph 4.5.27.2, steps (a) through (e). The coating system shall show no signs of damage.

4.6 Toxicity and waste disposal characteristics. The supplier shall provide the toxicological data and formulations required (see 3.3) to evaluate the safety of the material proposed for use. The manufacturer shall provide current procedures for disposal per federal EPA regulations.

4.7 Filler materials. The contractor shall furnish certification that the cleaning compound contains only the materials allowed and does not contain any filler materials disallowed per 3.2.

4.8 Qualitative identification of components (Types I, II, III, and IV).

4.8.1 Gas chromatogram (Type I only). A gas chromatogram of the Type I product shall be provided by a Government approved qualification laboratory (see 3.4). The chromatogram shall report all salient instrumental parameters (column type and dimensions, temperature(s), carrier gas and flow rate, detector type, sample dilution(s), etc. required to produce it.

4.8.2 Infrared spectrogram (Types II, III, and IV). Infrared spectrograms of the nonvolatile matter shall be prepared by a Government approved qualification laboratory (see 3.4). The spectrogram, including method for sample preparation, shall be provided to the qualifying activity by the qualification laboratory.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity

6. NOTES

6.1 Intended use. The four types of cleaning compounds covered by this specification are intended to be used for cleaning Aerospace Equipment including aircraft, aerospace ground equipment (AGE) and AGE engines. These cleaners will be used in place of other cleaners when approved by the System Program Manager of the equipment being cleaned. Type I should be used only on polyurethane and enamel coatings as it may attack acrylic nitrocellulose lacquer coatings found in numerous aircraft. Types I and IV materials are intended for light to heavy duty removal of greases, oils, hydraulic fluid, and carbon. Type II is intended for light to medium cleaning and is not intended to remove heavy soils. Types II and IV cleaning compounds are also intended for cleaning aircraft and aerospace ground equipment surfaces of contaminants prior to coating or recoating with primers, topcoats, sealants and adhesives. Types I, II and IV must be diluted with water before use. Type III is intended for light to heavy duty removal of greases, oils, hydraulic fluid, and carbon in wheel wells, wing butts and other areas where complete rinsing with water can be tolerated. After cleaning, rinse off with water. These cleaners are not intended to be used as canopy cleaners. These products have not been tested for use at elevated temperatures.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of this specification.
b. Type I, Type II, Type III or Type IV.
c. Size containers required.
d. QPL reference or test number.
e. Level of packing required.
f. Palletization, when applicable.

6.3 Material safety data sheets. Contracting officers should identify those activities requiring copies of completed Material Safety Data Sheets prepared in accordance with FED-STD-313.

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable QPL whether or not such products have actually been so listed by that date. The attention of the contractors is called to this requirement, and contractors are urged to arrange to have their products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from the qualifying activity (see 3.1.3).

6.5 Conformance tests. Conformance inspection should consist of examinations and tests necessary to ensure that production items meet specification requirements. Conformance inspection should include a description of the inspection procedure, sequence of inspections, number of units to be inspected, and the criteria for determining conformance to the requirement specified. Conformance examinations and tests should not duplicate any long term or special tests that were used to justify inclusion of qualification in a specification.

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

6.7 Key words.

AGE

Biodegradable

Gel-type

QPL

Terpene

Custodians:
Air Force - 68
Navy - AS

Review activities:
Air Force - 11
DLA - GS

Preparing activity:
Air Force - 68
(Project 6850-1441)

Appendix A

TABLE I. Quantitative Requirements

REQUIREMENT	TYPE I		TYPE II		TYPE III		TYPE IV		TEST METHOD
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Insoluble Matter (WT%)		0.05		0.05		0.05		0.05	4.5.2
Flash Point (°F)									
10% Solution	200								
Concentrated Solution	120		None 1/		None1/		None 1/		4.5.7
Emulsion Characteristics (ml free water)									
5 min		5.0		5.0		5.0		5.0	
8 hours	13.0								4.5.8
24 hours			13.0		8.0		11.0		
Wet Adhesion Tape Test			Pass				Pass		4.5.27
% Cleaning Efficiency	95		65		65		90		4.5.21
Terpene Hydrocarbons (% WT)	25	40	---	None	---	None	---	None	4.5.23

1/ No flash point should be observed up to the boiling point of the compound.

Appendix A

TABLE II. Total Immersion Corrosion Requirements

Alloy	Average of 3 Panels Weight Loss, Max (mg/cm^2/168 hrs)
Magnesium (AZ 31B-H24) AMS 4377 surface treatment per SAE AMS M-3171, Type III	0.50
Aluminum, SAE AMS QQ-A-250/4,T3 surface treatment per MIL-A-8625, Type I, Class I	0.15
Aluminum, SAE AMS QQ-A-250/4, Bare T3 Alloy	0.15
Aluminum, SAE AMS QQ-A-250/12, Bare T6 Alloy	0.15
Titanium, SAE AMS T-9046, 6AL-4V Class III, Composition C	0.10
Steel, AMS 5046, SAE 1020	0.25
Steel, 410 SS, Silver Plated per SAE AMS 2410	0.10

Appendix A

TABLE III. Sampling for Tests

Number of Containers in lot	Number of Containers to be sampled
2 to 15	2
16 to 25	3
26 to 90	5
91 to 150	8
151 to 280	13
281 to 500	20
501 to 1200	32
1201 to 3200	50
3201 to 10000	80
10001 to 35000	125
35001 to 150000	200
150001 to 500000	315
500001 and over	500

TABLE IV. Test Panel Finishes

Primer Coatings				
Panel Set No.	Primer Material Specification	Dry Film Thickness Per Coat/ mm (inches)	No. of Coats	Drying Time Before Topcoating
EH	MIL-PRF-23377, Type I, Class C High-Solids Epoxy Primer	0.0152-0.0229 (0.0006-0.0009)	1	2 - 8 hours

Top Coats, Color Number 17925 per FED-STD-595						
Panel Set	Topcoat Material	Dry Film Thickness Per Coat/ mm (inches)	No. of Coats	Drying Time Between Coats	Dry Film Thickness mm (inches)	Days to Dry Before Testing
E	MIL-PRF-22750 Coating, Epoxy Topcoat	0.0203 - 0.0305 (0.0008 - 0.0012)	2	1 hour	0.0406-0.0610 (0.0016 - 0.0024)	7
H	MIL-PRF-85285 Type I Coating: Polyurethane, High Solids	0.0203 - 0.0305 (0.0008 - 0.0012)	2	1 hour	0.0406-0.0610 (0.0016 - 0.0024)	7

TABLE V. Control Formula for the Cleaning Efficiency Test

Component	Control Formula Composition (% by weight) 1/
d-limonene	30.0
diethanolamine	5.0
nonionic surfactant (Triton X-100)	5.0
distilled water (ASTM D 1193, Type IV)	60.0

1/. This formulation is corrosive and intended solely for use as the control for the cleaning efficiency test. It will not qualify to the requirements in this specification.

TABLE VI. Test Panel Finishes

Primer Coatings				
Code	Primer Material Specification	Dry Film Thickness Per Coat/ mm (inches)	No. of Coats	Drying Time Before Topcoating
A	MIL-PRF-23377,Type I, Class C Primer Coatings; Epoxy, High-Solids	0.0152 - 0.0229 (0.0006 - 0.0009)	1	2 - 8 hours
B	MIL-PRF-85582, Type I, Class 1B Primer Coatings: Epoxy, Waterborne	0.0152 - 0.0229 (0.0006 - 0.0009)	1	2 - 8 hours
C	TT-P-2760, Type I, Class C Primer Coating: Polyurethane, Elastomeric, High-Solids	0.0380 - 0.0510 (0.0015 - 0.0020)	1	2 - 8 hours

Top Coats						
Code	Topcoat Material	Dry Film Thickness Per Coat/ mm (inches)	No. of Coats	Drying Time Between Coats	Dry Film Thickness mm (inches)	Time Before Testing (Days)
D	MIL-PRF-85285, Type I Coating: Polyurethane, High-Solids	0.0203 - 0.0305 (0.0008 - 0.0012)	2	1 hour	0.0406 - 0.0610 (0.0016 - 0.0024)	7

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7, and send to preparing activity.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-87937D	2. DOCUMENT DATE (YYYYMMDD) 20010924

3. DOCUMENT TITLE CLEANING COMPOUND, AEROSPACE EQUIPMENT

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON *(if applicable)*	**7.DATE SUBMITTED** (YYYYMMDD)

8. PREPARING ACTIVITY

a. NAME Code (68) DET 3 WR-ALC/AFTT, Bldg. 1621-K	b. TELEPHONE *Include Area Code)* (1) Commercial (2) AUTOVON
c. ADDRESS *(Include Zip Code)* 2261 Hughes Ave. Ste 123 Lackland, AFB, TX 78236-9823	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman road, Suite 2533 Ft. Belvoir, VA 22060-2533 Telephone (703) 767-6888 AUTOVON 427-6888

Appendix B

SMI Results from Eagle Kleen I Analytical Testing

SMI, Inc.

12219 SW 131 Avenue
Miami, Florida 33186-6401 USA

Phone: (305) 971-7047
Fax: (305) 971-7048

Attn: BATTELLE MEMORIAL INSTITUTE
505 King Avenue
Columbus, OH 43201

Date: 20-Sep-2004
SMI REF: 04JUL562

PRODUCT: **EAGLE KLEEN**
(received 14-Jul-2004)

40 CFR 796.3100: AEROBIC AQUATIC BIODEGRADATION

Code of Federal Regulations
Environmental Protection Agency
Title 40: Protection of Environment
Part 796: Chemical Fate Testing Guidelines
Shake Flask Method

Summary of Results:

Based on dissolved organic carbon analysis:

"EAGLE KLEEN" = 87.8 % Biodegradable in 28 days

See Appendix A for graphical representation of Biodegradability vs. Time .

PROCEDURE

I. Introduction

This procedure provides a way to determine the rate and extent of aerobic biodegradation that might occur when chemical substances are released to aquatic environments. A high biodegradability result in this test provides evidence that the test substance will be biodegradable in natural aerobic freshwater environments. A low biodegradability result may not necessarily indicate poor biodegradation, as other factors may interfere, such as inhibition of the microbial inoculum by the test material.

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II. Principle of the Test Method

The method consists of a 2-week inoculum buildup period during which the microbes are allowed to adapt to the test compound. The acclimated media containing a defined amount of test compound is added to specially equipped Erlenmeyer flasks. The test media is sampled periodically and analyzed for dissolved organic carbon (DOC). A reservoir filled with barium hydroxide is utilized to measure the amount of carbon dioxide evolved. The degree of biodegradation is determined by comparison of the extent of DOC disappearance and the amount of carbon dioxide liberated. Control flasks containing no test compounds are run simultaneously and are used to estimate the degree of ultimate biodegradation. Reference substances which will exhibit ultimate biodegradation may be run simultaneously to check the activity of the inoculum. If the reference samples do not exhibit at least 60 percent of theoretical maximum carbon dioxide, and at least 70 percent DOC removal within 28 days, the test will be regarded as invalid and shall be repeated using different inoculum.

This method is believed to be appropriate for a screening test which has solely an acceptance but no rejective function.

III. Test Procedure

The total organic carbon (TOC) of the test compound is first determined by analysis or calculation if the formulation is known. Determination of the minimum inhibitory concentration is useful to insure that the test compound will not be inhibitory to the microbes at the required concentration. The shake flask apparatus is assembled utilizing a 2-liter Erlenmeyer flask and a 50 ml centrifuge tube. The tube containing 10 mls of barium hydroxide will be suspended over the contents of the flask in such a way that liberated carbon dioxide may diffuse into the barium hydroxide, while allowing the contents of the tube to be removed for analysis without spilling into the test media. Glass tubing may be utilized as access into the flask for sparging, venting, and sampling.

Stock solutions I, II, and III are prepared (see Appendix B), along with 0.2 N barium hydroxide and 0.1 N HCl. Acclimation medium is prepared by adding 1 ml each of stock solutions I, II and III to 1 liter of distilled, deionized water (DIW). The microbial inoculum is obtained from sewage and soil or from Polyseed and is added to the acclimation medium. Test compounds are added incrementally during the acclimation period at concentrations equivalent to 4, 8, and 8 mg/L carbon on days 0, 7, and 11, respectively. On day 14, the medium is ready for use in the test.

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Biodegradability test flasks are prepared by adding 100 mls of acclimation medium to 900 mls of DIW along with 1 ml each of solutions I, II, and III to the 2-liter Erlenmeyers. Additional test compound equivalent to 10 mg/L carbon is added to the flasks. Ten mls of barium hydroxide are added to the suspended reservoirs in each flask and 10 mls are also saved for use as a titration blank. Flasks are sparged with carbon dioxide-free air, sealed and placed on a shaking table (approx. 125 rpm) at 20 - 25 deg C in the dark. Test flasks should be run in triplicate and sampling should occur at time zero and at least four other times to allow for a smooth plot of biodegradation. Each sample for DOC analysis is first centrifuged or filtered through a 0.45 micrometer or smaller pore diameter. On the day prior to terminating the test, 3 mls of 20 percent sulfuric acid are added to release carbonate bound carbon dioxide.

IV. ANALYTICAL MEASUREMENTS

The quantity of carbon dioxide evolved is measured by titration of the entire barium hydroxide sample with 0.1 N HCl to the phenolphthalein end point, blank subtracted. Theoretically, 10 mg of carbon is converted to 0.833 mmol of carbon dioxide. Absorbed carbon dioxide precipitates as barium carbonate, causing a reduction in alkalinity by the equivalent of 16.67 ml of 0.1 N HCl for complete conversion of the test compound carbon to carbon dioxide. Therefore, the percent theoretical carbon dioxide evolved from the test compound is calculated at any sampling time from the formula:

$$\% CO_2 \text{ evolution} = [(TF - CF)/16.67] \cdot 100$$

where:

TF = mls of 0.1 N HCl used in titration of test flask

CF = mls of 0.1 N HCl used in titration of control flask

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The DOC analysis is performed using a suitable organic carbon method. The percent DOC disappearance from the test compound is calculated from the formula:

$$\% \text{ DOC removal} = [1 - (DTF_x - DCF_x)/(DTF_o - DCF_o)] \cdot 100$$

where:

DTF = Dissolved organic carbon from test flask
DCF = Dissolved organic carbon from control flask

o = Day zero measurements
x = Day x measurements

V. REPORT OF RESULTS

Inoculum: Polyseed and Mixed inoculum

Date Received: July, 2004

Source: Fisher Scientific and Metro-Dade County Water & Sewer Authority

Storage: Ambient temperature, used within 24 hours

Minimum Inhibitory Concentration: MIC < 3.125 % (non-inhibitory to microbes at concentrations lower than 3.125%)

Percent Biodegradation based on DOC analysis:

EAGLE KLEEN:	**87.8 %** after 28 days (see Table 1)
Reference (Sodium citrate):	92.3 % after 28 days (see Table 1)

Percent Biodegradation based on carbon dioxide evolution:

EAGLE KLEEN:	34.5 % after 28 days (see Table 2)
Reference (Sodium citrate):	42.7 % after 28 days (see Table 2)

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Summary: Since the test compound was found to be over 70 % biodegradable based on the DOC analysis, it is reasonable to assume that the substance will undergo rapid and ultimate biodegradation in aerobic aquatic environments, also known as "ready biodegradability". The test is validated by the fact that the reference compound, sodium citrate, exhibited a biodegradability over 70%.

The percent biodegradability based on carbon dioxide evolution is typically lower than that of the DOC based numbers. In this case, the carbon dioxide evolution measured was significant, both on the test compound and on the reference, and the results generally agree.

Respectfully submitted,

Patricia D. Viani
SMI, Inc.

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TABLE I - DISSOLVED ORGANIC CARBON (DOC) VALUES

Sample: **EAGLE KLEEN**

		DAY 0	DAY 7	DAY 14	DAY 21	DAY 28
	A	38.2	12.7	9.5	8.1	8.1
	B	35.7	8.2	7.5	7.2	7.2
	C	37.9	7.1	7.0	7.1	7.2
AVERAGE		37.3	9.3	8.0	7.5	7.5
CORRECTED AV		34.1	6.0	4.7	4.2	4.2
% BIODEGRADED		**N/A**	**82.5%**	**86.3%**	**87.8%**	**87.8%**

Reference: Sodium Citrate

	A	38.8	9.5	5.9	5.7	5.8
	B	37.1	12.9	8.2	6.3	6.1
	C	36.2	10.7	7.1	5.9	6.0
AVERAGE		37.4	11.0	7.1	6.0	6.0
CORRECTED AV		34.2	7.7	3.7	2.7	2.6
% BIODEGRADED		N/A	77.6%	89.1%	92.2%	92.3%

BLANK	A	3.3	3.5	3.2	3.1	3.6
	B	3.2	3.2	3.5	3.6	3.0
	C	3.0	3.4	3.3	3.2	3.4
AVERAGE		3.2	3.4	3.3	3.3	3.3

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Table II - Titration Data for CO2 Evolution

Sample: **EAGLE KLEEN**

			DAY 7	DAY 14	DAY 21	DAY 28	
	A		4.2	11.8	17.4	17.6	
	B		5.2	13.8	17.4	18.2	
	C		4.6	10.2	17.2	18.2	
AVERAGE			4.7	11.9	17.3	18.0	
CORRECTED AVG			12.9	5.9	0.7	0.1	
% BIODEGRADED			22.6%	10.4%	1.3%	0.2%	
mls theoretical:		56.9				**TOTAL=**	**34.5%**

Reference: Sodium Citrate

	A		3.4	11.8	16.8	18.2	
	B		3.8	7.8	17.2	18.0	
	C		3.8	7.4	15.8	17.8	
AVERAGE			3.7	9.0	16.6	18.0	
CORRECTED AVG			13.9	8.9	1.5	0.1	
% BIODEGRADED			24.3%	15.6%	2.6%	0.2%	
mls theoretical:		57.0				TOTAL =	42.7%
BLANK	A		17.8	18.2	18.0	18.2	
	B		17.0	17.6	18.2	17.8	
	C		17.8	17.8	18.0	18.4	
AVERAGE			17.5	17.9	18.1	18.1	

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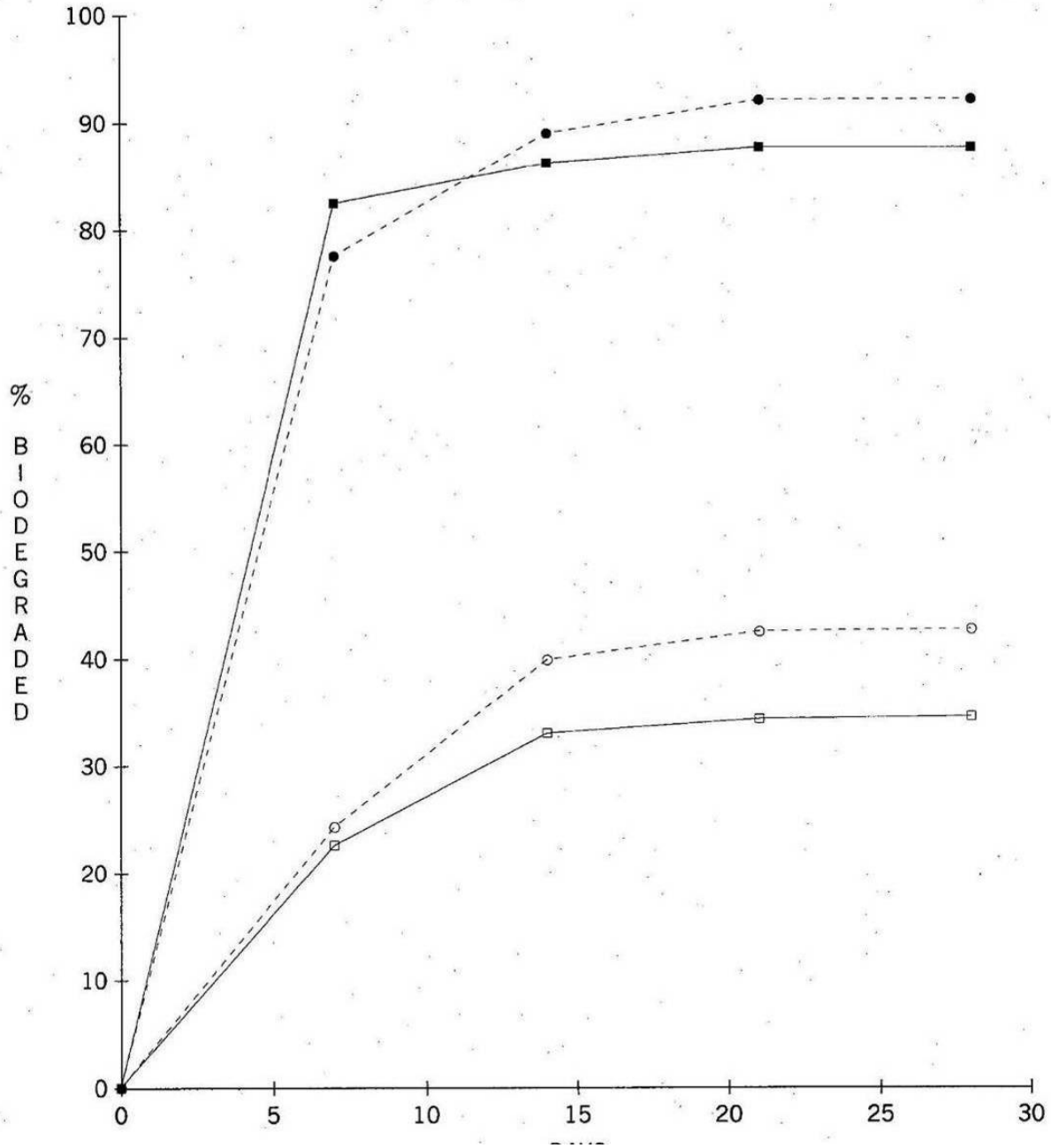
Appendix A

BIODEGRADABILITY VS. TIME

EAGLE KLEEN



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Appendix B

STOCK SOLUTIONS I, II, AND III

SOLUTION I:	35	g/L	NH_4Cl
	15	g/L	KNO_3
	75	g/L	$K_2HPO_4 \cdot 3H_2O$
SOLUTION II:	25	g/L	$NaH_2PO_4 \cdot H_2O$
	10	g/L	KCl
	20	g/L	$MgSO_4$
	1	g/L	$FeSO_4 \cdot 7H_2O$
	adjust pH of Soln II to 3.0		
SOLUTION III:	5	g/L	$CaCl_2$
	0.05	g/L	$ZnCl_2$
	0.5	g/L	$MnCl_2 \cdot 4H_20$
	0.05	g/L	$CuCl_2$
	0.001	g/L	$CoCl_2$
	0.001	g/L	H_3BO_3
	0.0004	g/L	MoO_3

Appendix C

SMI Results from Eagle Kleen II Analytical Testing

SMI, Inc.

12219 SW 131 Avenue
Miami, Florida 33186-6401 USA

Phone: (305) 971-7047
Fax: (305) 971-7048

Attn: Sara F. Kuczek
Battelle Memorial Inst.
505 King Avenue
Columbus, OH 43201

Date: 30-Sep-2004

SMI/REF: 04AUG682

Product: **EAGLE KLEEN II** *(received 10-Sep-2004)*

Dilution: Ready to Use

Modified partial testing of section 3.7, Effect on Metals
(product was tested neat - [undiluted])
MIL-PRF-87937D (24 Sep 2001)
CLEANING COMPOUND, AEROSPACE EQUIPMENT
Type IV - Heavy Duty, Water Dilutable Cleaning Compound

3.7	Effect on metals	
3.7.1	Hydrogen embrittlement	Conforms*
3.7.2	Total immersion corrosion	Does not conform*
3.7.3	Low-embrittling cadmium plate corrosion	Does not conform*
3.7.4	Effects on unpainted metal surfaces	Not performed
3.7.5	Sandwich corrosion	Conforms*
3.7.6	Wet adhesion tape test	Not performed

** Test performed using "as received" solution (ready to use) instead of dilution required by specification. Results should not be considered for QPL listing.*

Respectfully submitted,

Patricia D. Viani, SMI Inc.

3.7 Effect on metals

3.7.1 Hydrogen embrittlement: When tested in accordance with 4.5.9, the concentrated cleaner (all types) and a 10% solution of the cleaner (Types I, II, and IV only) in distilled water shall not cause hydrogen embrittlement of cadmium plated or IVD aluminum coated AISI 4340 steel.

Test temperature: 21 - 23°C (69 - 73°F)
Specimens: Type 1c, ***cadmium*** *plated in accordance with Treatment B of ASTM F519*

As received: ***No failures within 150 hours.***
Dilute (10 %): ***Not performed***

Result Conforms*

Test temperature: 21 - 23°C (69 - 73°F)
Specimens: Type 1c, grit blasted, ***IVD Aluminum*** *plated per MIL-DTL-83488D, Cl 2, Ty I.*

As received: ***No failures within 150 hours.***
Dilute (10 %): ***Not performed***

Result Conforms*

** Test performed using "as received" solution (ready to use) instead of dilution required by specification.*

3.7.2 Total immersion corrosion: When tested in accordance with 4.5.10 (ASTM F 483), the concentrated cleaning compound (all types) and a 10% solution of the cleaning compound (Types I, II and IV only) in distilled water shall not show any indication of staining, etching, pitting, or localized attack on any of the panels, or cause a weight change of an average of three (3) test panels greater than that shown in Table II. A slight discoloration of the panels shall not be objectionable. The cleaning compound shall not layer or separate for the duration of the test.

Table II Total Immersion Corrosion Requirements

Alloy	Weight Loss (mg/cm^2/168hrs)		
	Maximum allowed	**As received**	**10 %**
Magnesium (AZ 31B-H24) AMS 4377 surface treatment per SAE AMS-M-3171, Ty III	0.50	**0.14**	**NOT PERFORMED**
Aluminum, SAE AMS-QQ-A-250/4, T3 surface treatment per MIL-A-8625, Type I, Class I	0.15	**0.01**	
Aluminum, SAE AMS-QQ-A-250/4, Bare T3 Alloy	0.15	**0.01**	
Aluminum, SAE AMS-QQ-A-250/12, Bare T6 Alloy	0.15	**0.01**	
Titanium, SAE AMS-T-9046, 6Al-4V CI III, Comp. C	0.10	**0.01**	
Steel, AMS 5046, Grade 1020	0.25	**0.57**[1]	
Steel, 410 SS, Silver Plated per SAE AMS 2410	0.10	**0.01**	

[1]Exceeds allowable weight change; significant discoloration/darkening

Result Does not conform*

3.7.3 Low-embrittling cadmium plate corrosion: Steel panels coated with low-embrittling cadmium plate immersed in the concentrated cleaning compound (all types) and a 10% solution of the cleaning compound (Types I, II and IV only) in distilled water shall not show a weight change greater than 0.14 mg/cm^2 for 24 hours when tested in accordance with 4.5.11.

As received: ***0.20* mg/cm²/24hrs***
Dilute (10 %): *Not performed*

Result Does not conform*

** Test performed using "as received" solution (ready to use) instead of dilution required by specification.*

3.7.4 Effects on unpainted metal surfaces: The concentrated cleaning compound (Type III only) and a 10% solution (Types I, II and IV only) of the cleaning compound in distilled water shall not cause streaking, stains or other deposits that cannot be easily removed with water when tested in accordance with 4.5.12.

Result Not performed

3.7.5 Sandwich corrosion: When tested in accordance with 4.5.16, the concentrated cleaner (all types) and a 10% solution (Types I, II and IV only) shall show no corrosion in excess of that shown by control test coupons in ASTM D 1193, Type IV, reagent water.

	2024-T3 Bare Anodized	2024-T3 Alclad	7075-T6 Bare Anodized	7075-T6 Alclad
As received	**1**	**1**	**1**	**1**
Dilute (10%)	**Not performed**			
Control	1	1	1	1

Result Conforms*

3.7.6 Wet adhesion tape test (Types II and IV): A ten (10) percent solution of the cleaning compound, when used as directed, shall remove soil from a painted surface in preparation fro repainting such that paint applied after cleaning with the compound shall adhere to the surface when tested in accordance with 4.5.27.

Result Not performed

** Test performed using "as received" solution (ready to use) instead of dilution required by specification.*